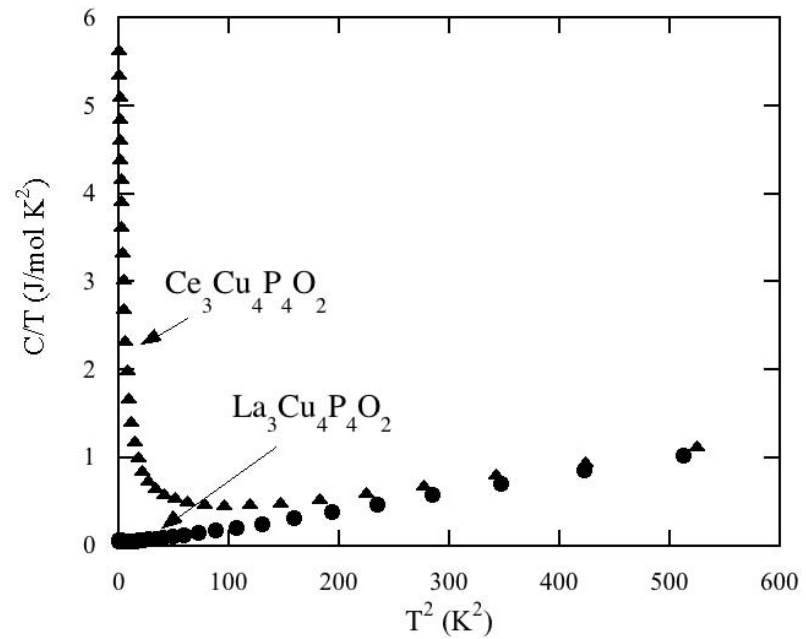
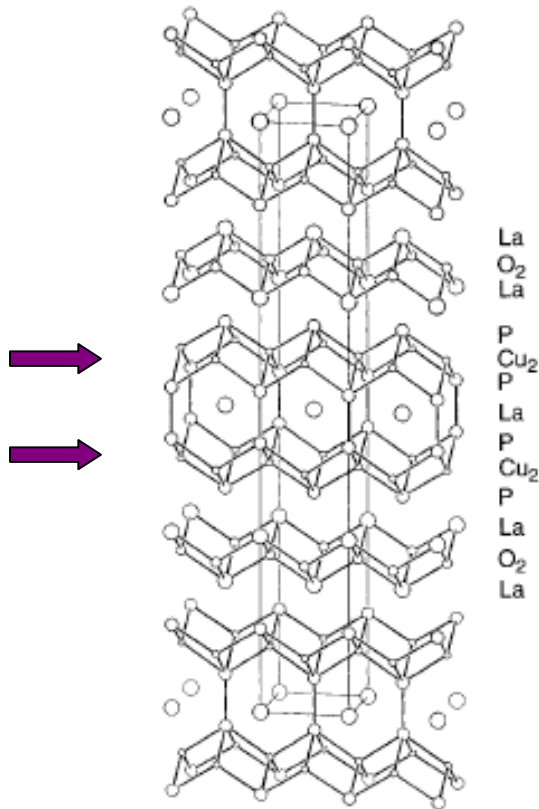


# CAREER: Synthesis and investigation of novel condensed matter materials and development of a high-resolution capacitive dilatometer

John J. Neumeier, Montana State University, DMR-0301166

- Cu pnictides have structural similarities to high- $T_c$  compounds with planes of Cu-P tetrahedra, they are metallic, but their physical properties have not been investigated in detail.*
- We have observed a large enhancement of the electronic heat capacity coefficient  $\gamma$  in  $\text{Ce}_3\text{Cu}_4\text{P}_4\text{O}_2$ . We are also searching for superconductivity under pressure.*



- $\gamma = 100$  mJ/mole-K<sup>2</sup> for  $\text{Ce}_3\text{Cu}_4\text{P}_4\text{O}_2$   
(Note: Nuclear Schottky anomaly causes large upturn at low temperature.)

It is important to investigate unusual condensed matter materials in order to learn about their physical properties, how these properties compare to those of known compounds, and how structure, composition, etc. is related to those physical properties. This particular compound is similar, in terms of structure, to high temperature superconductors although it has Cu-P planes instead of Cu-O planes. Two-dimensional (planar) materials are known to exhibit very unusual properties, and this compound has not been studied in very much detail. Our goal is to elucidate the properties of this system and expand our basic knowledge.

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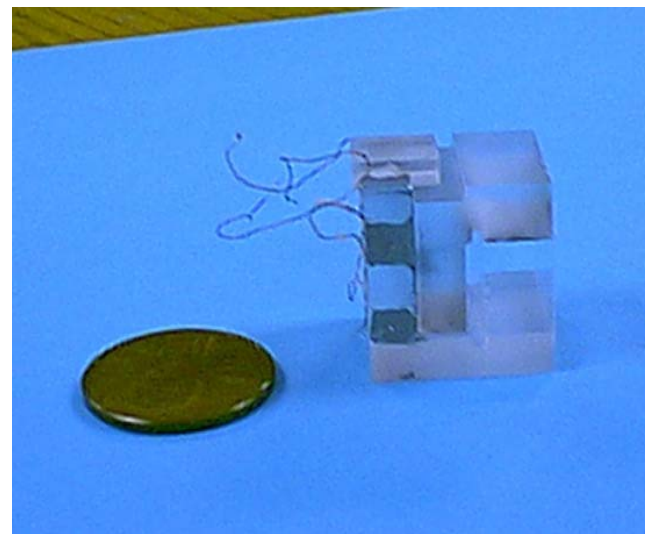
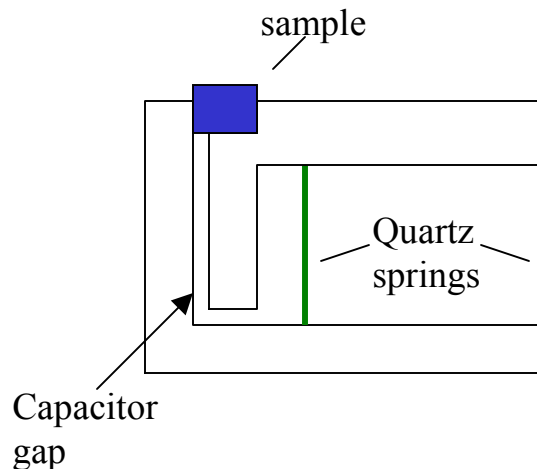
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## Student and visitor involvement in our laboratory

**(in 2004):** *Two graduate students (Hiroto Terashita and Richard Bollinger), one undergraduate student through our NSF REU program (Brian Myer, sophomore from Appalachian State University), one visiting graduate student (José Souza from Universidade, Sao Paulo, Brazil), and one high school teacher (Buck Marsh from East Valley High School, Yakima, WA).*

## A new thermal expansion cell for the NHMFL:

*Our REU student from 2003, John Macaluso, designed, constructed, and calibrated a new quartz thermal expansion cell for use at the high magnetic field laboratory. He is continuing this work in collaboration with Luis Balicas at NHMFL REU program. The cell is currently being tested for use in the 30 tesla magnet down to He<sup>3</sup> temperatures. It will become available to the NHMFL user community.*



The NHMFL quartz dilatometer cell.

The quartz dilatometer cell is very unusual in that its own intrinsic thermal expansion is very small. This allows the measurement of small samples (change in length proportional to length), and samples with small thermal expansions. In the category of small samples, often novel condensed matter materials are only available as sub millimeter sized single crystals. This cell is the only one in the world that could measure these. Our hope is to make this available to many users in the NHMFL community.